IoT Based Coal Mine Safety System Using Raspberry Pi

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Abstract- Now a day's due to global warming and climate changes there are challenging situations in coal mine. To reduce the cost as well as to improve the productivity along with product quality the automation in the field of coal mine is necessary, which will also reduce the mine workers efforts. This project proposes a design of a IOT system , by the help of Raspberry pi controller which is able to monitor the temperature, humidity, gas and status of smoke in an under ground mine. This system utilizes low power, cost effective Raspberry pi, a temperature sensor, humidity sensor , gas sensor for sensing the mine climate parameters and Wi-Fi for remote logging of data at central location to control the climate state. Every sensor values gets reported to web page at every certain interval of time. If there is any sudden increase in any of those sensor values along with data log, video has been captured and sends to the server's mail.

Keywords- Wi-Fi,IOT,Web

I. INTRODUCTION

Underground mines are usually extensive labyrinths, of which the tunnels are generally long and narrow with a few kilometers in length and a few meters in width. Thousands of mining personnel are needed to work under extreme conditions according to the construction requirements, and hundreds of miners die from mining accidents every year. It is now widely approved that the underground mining operations are of high risk. In this view, a monitoring and control system needs to be deployed as one important infrastructure in order to ensure the mining safety and coordinate various tasks. However, underground coal mines mainly consist of random passages and branch tunnels, and this disorganized structure makes it very difficult to deploy any networking skeleton. In such a case, the utilization of a wireless sensor network (WSN) and other sensing devices may have special advantages for realizing the automation of underground monitoring and control due to the rapid and flexible deployment. In addition, the multihop transmitting method can well adapt to the tunnel structure and thus provide enough scalability for the construction of a mining system, and it is very suitable to the comprehensive monitoring and controlling coalmines, which can effectively compensate the deficiencies of the exiting underground cable monitoring system . Traditionally, coal mine safety monitoring and automation systems were typically designed to meet the requirements of a single monitoring application. The coal mine application has already gone beyond the interconnection of a few large back-end systems, and more and more underground physical devices make the state of objects and their surroundings seamlessly accessible to software systems .As a matter of fact , most works are based on monolithic system architectures, which are brittle and difficult to adapt. A necessary step towards coal mine monitoring and control automation is to provide timely and fine-grained comprehensive alarming information and corresponding disposal process .It is necessary so that it allows the users to identify the levels for coal mine safety alarming, and possibly to adjust monitoring and control rules to ensure the coal mine safety. Furthermore, the user can also control the physical devices remotely via the Web. Currently available coal mine safety monitoring and control systems that focus on the real-time information collection are useful ,but cannot meet the user needs fully with a very high usage obstacle and often requires a complex operation definition and configuration for monitoring and control automation applications, and cannot meet the demand for ad-hoc services by the end users . Recently, in the area of comprehensive application integration, some works have introduced the use of "mashup " concepts , also known as user-generated comprehensive applications. However, they mainly focus on mashing up information services and do not address the requirements that come with physical devices integration. The middleware for coalmine monitoring and control automation needs to rapidly coordinate interaction between the business processes and distributed ,multisource sensory devices Also , the middleware for coal mine monitoring and control automation should change dynamically in are all-time way confronting with continuously and constantly changing for the underground coal mine physical world .With the help of visualization technology, the graphical user interface of different underground physical sensor devices could be created, which allows the sensors to combine with other resources easily.

II. EXISTING SYSTEM

In Existing system, Coal mine safety systems are using wired communication. It is expensive and makes difficulty to use wires in mines. Even measuring all parameters, it may crash if any disaster happens.

A. PROPOSED SYSTEM

- IOT Technology based communication
- The Internet of Things is regarded as the third wave of information technology after the Internet and mobile communication network, which is characterized by more thorough sense, measure and intelligence.
- In this system sensors are detecting the parameters every time, when there is any sudden change in any of the parameter it gets reported via IoT

B. ADVANTAGES:

- Easy to monitor & control
- High efficient

III. BLOCK DIAGRAM

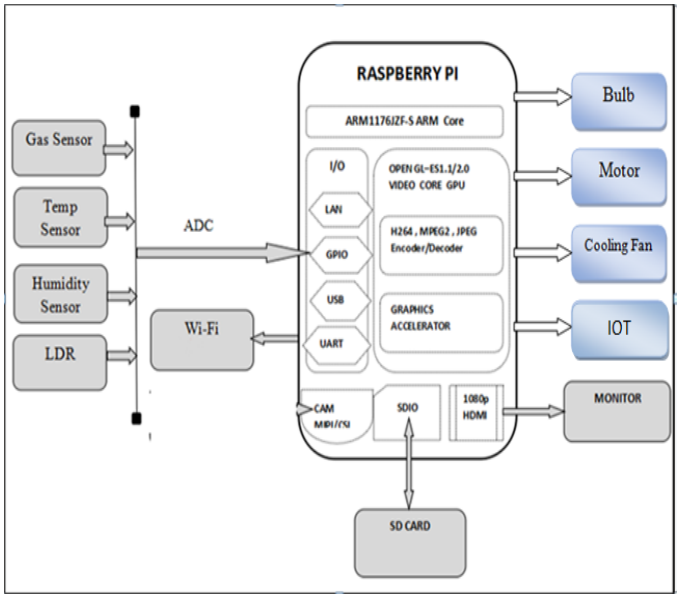

Fig.1: BLOCK DIAGRAM

This system consists of raspberry pi, ARM11 microcontroller and parameters of global process. The parameters that can be tracked are temperature , Dangerous gases light intensity and water level. Those parameters are measured byindividual sensors along with ARM11 controller .in that node the whole system is controlled by Arm11 processor and this processor is implemented on Raspberry Pi Board. So this board is connected with monitor, camera, and SD card. Those all components are connected by USB adaptors. The parameters value from the arm controller is displayed in monitor and control through raspberry pi.

- Sensors are connected to the GPIO pins of raspberry pi throug h ADC, to convert the analog sensor values from analog to dig ital.

IV. HARDWARE TOOLS

A. RASPBERRY PI

Raspberry Pi Core Module

The core module of the system is realized using a Raspberry Pi 3 board; it's a $ 35 bare-bones computer designed and developed by the Raspberry Pi Foundation, the Pi 3 features a BCM 2837 System-on-Chip which includes a Quad-Core 64-Bit ARM Cortex A7 CPU clocked at 1.2GHz paired with 1 GB of RAM. It also has Video Core IV GPU for graphical processing applications, it also includes four USB ports for peripherals and 40 Pin General Purpose Input Output (GPIO) pins for interfacing the Pi with external electronic circuits, these GPIO pins are used to interface the Pi to the module. The Raspberry Pi is designed to run various Linux based operating systems and has Raspbian as its official operating system and Python as its official programming language.

Fig.2: Raspberry Pi 2 Module

B. DHT11

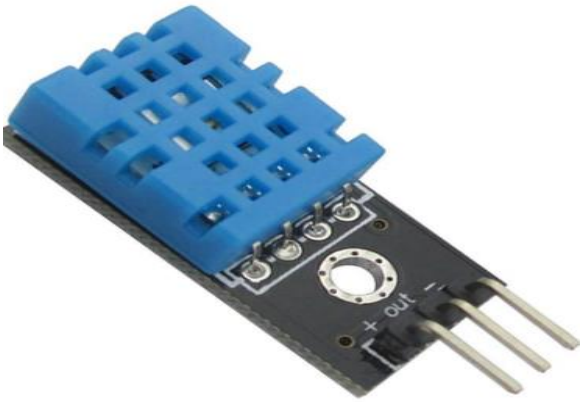

FIG.3: DHT11

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins

needed). Its fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.
Compared to the DHT22, this sensor is less precise, less accurate and works in a smaller range of temperature/humidity, but its smaller and less expensive</br<>
We have aAdafruit Learning System guide with schematics, Arduino&CircuitPython code, datasheets and more!
Comes with a 4.7K or 10K resistor, which you will want to use as a pullup from the data pin to VCC.

C. DC motor:

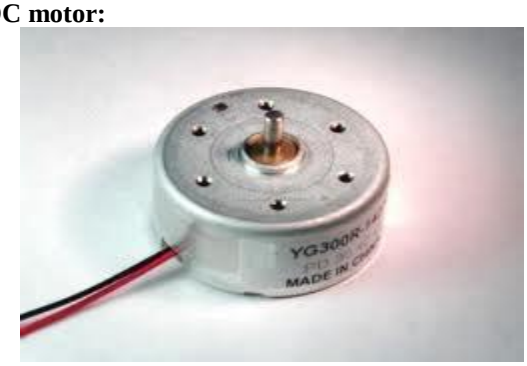

FIG.4: DC MOTOR

DC motors are configured in many types and sizes, including brush less, servo, and gear motor types. A motor consists of a rotor and a permanent magnetic field stator. The magnetic field is maintained using either permanent magnets or electromagnetic windings..Motors are the devices that provide the actual speed and torque in a drive system. This family includes AC motor types (single and multiphase motors, universal, servo motors, induction, synchronous, and gear motor) and DC motors (brush less, servo motor, and gear motor) as well as linear, stepper and air motors, and motor contactors and starters.

D. LDR SENSOR

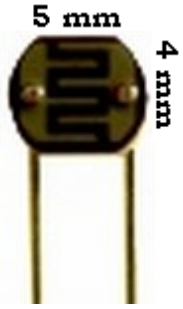

FIG.5: LDR SENSOR

A **Light Dependent Resistor** (LDR) or a photoresistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. There are many different symbols used to indicate a **LDR**, one of the most commonly used symbol is shown in the figure below. The arrow indicates light falling on it.

Working Principle of LDR

A light dependent resistor works on the principle of photo conductivity. Photo conductivity is an optical phenomenon in which the materials conductivity (Hence resistivity) reduces when light is absorbed by the material.
When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band. These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. Hence when light having enough energy is incident on the device more&more electrons are excited to the conduction band which results in large number of charge carriers. The result of this process is more and more current starts flowing and hence it is said that the resistance of the device has decreased . This is the most common working principle of LDR.

V. SOFTWARE TOOLS

A. Linux

Linux is a free open source working framework and it has a place with the Unix working frameworks. In reality Linux implies the piece itself which is the core of the working framework and handles the correspondence between the client and equipment. Regularly Linux is utilized to allude to the entire Linux dispersion.

Linux appropriation is a gathering of programming in view of the Linux Kernel. It comprises of the GNU-task's parts and applications. Since Linux is an open source venture, anybody can alter and circulate it.

B. Raspbian Wheezy

Raspbian Wheezy is a free working framework in view of Debian appropriation. It is made by a little group of designers who are enthusiasts of Raspberry Pi. Raspbian is improved for the Raspberry Pi's equipment and it accompanies more than 35 000 packag-es and pre-incorporated programming. Raspbian is still under dynamic advancement and it intends to enhance the solidness and execution of the Debian bundles

C. Python

Python is a multi-worldview programming dialect: protest arranged programming and organized writing computer programs are completely upheld, and there are various dialect highlights which bolster practical programming and viewpoint situated programming (counting by meta programming and by enchantment strategies). Numerous different standards are bolstered utilizing expansions, including configuration by contract and rationale programming.

D. Open-cv

OpenCV-Python is the Python API of OpenCV. It joins the best characteristics of OpenCV C++ API and Python dialect. OpenCV Python is a universally useful programming dialect begun by Guido van Rossum, which turned out to be extremely mainstream in brief time fundamentally due to its effortlessness and code lucidness. It empowers the software engineer to express his thoughts in less lines of code without decreasing any clarity. Contrasted with different dialects like C/C++, Python is slower. In any case, another vital component of Python is that it tends to be effectively reached out with C/C++. This component causes us to compose computationally concentrated codes in C/C++ and make a Python wrapper for it so we can utilize these wrappers as Python modules. This gives us two favourable circumstances: first, our code is as quick as unique C/C++ code (since it is the real C++ code working in foundation) and second, it is anything but difficult to code in Python. This is the manner by which OpenCV-Python works, it is a Python wrapper around unique C++ execution. Furthermore, the help of Numpy makes the errand more less demanding. Numpy is an exceedingly upgraded library for numerical tasks.

VI. RESULT

Fig.6: Hardware Design

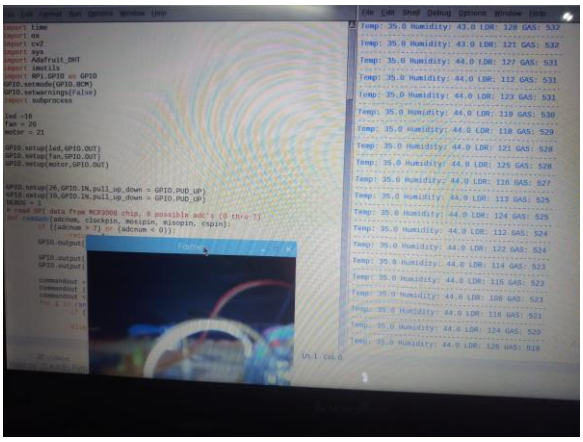

Fig.7: Displayed view of Result

VII. CONCLUSION

The designed robot is reliable to use and can be used in any working environment. The sensors which are used are so sensitive. The gas sensor will also detect other leakage such as hydrogen, smoke etc. This model can also be used for other purpose also. The work environment can be seen from the controller room itself. Since Wi-Fi is used, the data can be transmitted from any place. The suffocation of the labours working inside the mine is avoided. The accidents are prevented which are caused by ambient conditions. This application can be used for all industrial area where human intervention for security can be avoided. In hospitals, shopping malls also this application can be used. This project can be enhanced by placing a water sprayer in the robot. In case of any fire accidents water has to be sprayed at the right place. Also, some other sensors such as dust sensor, humidity sensor can be interfaced for further convenience of the workers.

VIII. REFERENCES

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